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Eight New Species of *Begonia* (Begoniaceae) from Murum Dam, Sarawak, Borneo

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Summary. Eight new species of *Begonia*, *B. chakensis* S. Julia & C.Y. Ling, *B. johariana* S. Julia & C.Y. Ling, *B. julaihiana* S. Julia & C.Y. Ling, *B. murumensis* S. Julia & C.Y. Ling, *B. plieranensis* S. Julia & C.Y. Ling, *B. rhodotricha* S. Julia & C.Y. Ling, *B. rhombipetala* S. Julia & C.Y. Ling and *B. tenuissima* S. Julia & C.Y. Ling are described from Sarawak. Currently all species are known only from the Murum Dam area. All species belong to the section *Petermannia* except for one species (*B. chakensis*) that is not placed in any section as the female flower and fruit are incompletely known. Species descriptions and colour photographs are provided for all species.

Our knowledge and understanding of *Begonia* in Borneo is hindered by the fact that the majority of the species remain undescribed and unnamed. The slow rate of publication of new species is in part due to the lack of complete specimen materials in local herbaria. In Borneo, currently a total of 126 species are named and described, representing approximately 20% of the species estimated for Borneo (Julia & Kiew, 2014). Of the 72 species recorded from Sarawak, 38 species are endemic to limestone habitats. Although limestone habitats are well known for harbouring high *Begonia* species diversity, other habitats such as lowland or hill forests and habitats associated with rivers and streams are also particularly rich in begonias. The Murum Dam area is no exception. The study of *Begonia* in the Murum Dam area was part of the WiMOR (Wildlife Monitoring and Rescue Operation) Project, the collaboration between Sarawak Forestry Corporation (SFC) and Sarawak Energy Berhad (SEB), to document, collect and maintain the *ex-situ* collections of plants affected by the rising waters of the dam.

The Murum Dam is located on Sungai (Sg.) Murum (114° 21.4'E to 114° 22.4'E and 2° 38.5' N to 2° 39.4' N), a tributary of Batang Rajang in Belaga District. The three main rivers affected by the dam are Sg. Murum and its major tributaries (Sg. Plieran and Sg. Danum). The reservoir lies between the base elevation of 410 m at the dam site and the maximum operating level of elevation (540 m), giving a depth of 130 m and the reservoir extends over an area of 245 km^2 (EIA, 2008).The area is poorly known botanically as most of the rivers in this area are inaccessible due to their remoteness and to the river conditions with dangerous rapids that are not navigable.

During the WiMOR project at Murum Dam, collections of selected plants including *Begonia* species were carried out between 2013 and 2014. The collections were made along the main river systems of Sg. Murum, Sg. Danum, Sg. Plieran, Sg. Palutan and its many smaller tributaries. Live plants were established *ex-situ* in Murum and the duplicates are deposited in the SFC Nursery at Semengoh Nature Reserve. The species descriptions are based on specimens collected during various field surveys to Murum Dam areas between 2013 and 2014 as well as materials from the nurseries. The measurements are based on live specimens unless otherwise stated.

This account is just the beginning of a comprehensive study of the begonias of Murum Dam. More taxa await detailed descriptions when complete materials (specimens with flowers and fruits) become available.

Description of New Species

1. Begonia chakensis S. Julia & C.Y. Ling **sp. nov.** (Section: Uncertain)

Similar to *Begonia johariana* in its creeping habit and the shape of bracts and bracteoles but it is different in being sturdier and having unbranched stems (vs. thinner and branched stems), the stems densely pilose (vs. sparsely covered with fine short white hairs), the stipules are larger, *ca*. 13–15 × 5–12 mm (vs. *ca*. 5–8 × 2–4 mm), the petioles grooved above (vs. terete), the leaves are larger, 11–13.8 × 6.6–8.5 cm (vs. 5–9 × 3–5 cm), the basal lobes shorter, *ca*. 5 mm long (vs. 8–20 mm long), the inflorescences with a single female flower and male inflorescences in a simple cyme to *ca*. 4 cm long (vs. paniculate inflorescences to 5 cm long), the pedicel of male flower is longer, 4–9 mm long (vs. *ca*. 3 mm long). Type: *Ling et al. BMHEP 3826,* Borneo, Sarawak, Belaga District, Murum, Sg. Chak (tributary of Sg. Danum), 20 March 2014 (holotype SAR!). (**Fig. 1**)

Low herb, sometimes rooting at the nodes and creeping. Stems, petioles and veins beneath densely pilose, hairs white to pale green. Stems pale brown or green, 2–4 mm thick, internodes 3.5–6 cm long, unbranched, succulent, thicker at nodes. Stipules pale green or brownish green, broadly ovate, 13–15 × 5–12 mm, keeled, margin serrate, apex acute, persistent. Leaves alternate, distant, oblique, held horizontally; petioles red-brown, (1.8–)

Fig. 1. *Begonia chakensis*. **A** & **B.** Habit; **C.** Stipule; **D** & **E.** Male flowers; **F.** Old fruit. All photos from *BMHEP 3826* by Ling Chea Yiing.

3.5–5 cm long, slightly grooved above; lamina plain green to dark green above, dark red or sometimes pale green tinged red beneath, young leaves pale green tinged red, wavy, in life succulent, glabrous, glossy, asymmetric, ovate, 11–13.8 × 6.6–8.5 cm, broad side 4.5–6 cm wide, base acute or slightly cordate, basal lobes *ca*. 5 mm long, margin minutely serrate, apex acuminate, acumen to 1–2.5 cm long; venation pinnate-palmate, veins greenish above except near the leaf base, dark red beneath, 3–4 veins on either side of the midrib, 1–2 veins in basal lobe, prominent on both surfaces. Inflorescences protogynous, axillary on the uppermost part of the stem, with single female flower and male inflorescences in a simple cyme to *ca*. 4 cm long. Bracts pale green, sometimes tinged red, ovate, 12–15 × 6–8 mm, margin serrate and ciliate, persistent. Bracteoles (lower part) pale green, upper ones white, ovate, 4–12 × 3–6 mm, margin ciliate, persistent. Male flowers: pedicel white, 4–9 mm long, glabrous; tepals

4, white, glabrous, margin entire, apex rounded, outer 2 tepals oval, 8–10 × 5 mm, inner 2 tepals lanceolate, *ca*. 5 × 2 mm; stamens 39–40, cluster globose, sessile; filaments yellow, *ca*. 1 mm long; anthers yellow, obovate, *ca*. 1 × 0.5 mm, apex emarginate. Female flowers: not seen. Capsules single, brown, *ca*. 6 × 11 mm, glabrous, wings 3, unequal, larger wing *ca*. 6 mm wide, smaller two *ca*. 4 mm wide, wings acute proximally, rounded distally, thinly fibrous, dehiscing between locule and wing; pedicel pendent, *ca*. 5 mm long.

ETYMOLOGY. Named for the stream where the species was collected (Sg. Chak).

ECOLOGY. Riparian forest at 586 m elevation.

DISTRIBUTION. Borneo. Endemic to Sarawak (Sg. Chak in Murum, Belaga District).

SPECIMEN EXAMINED—BORNEO. SARAWAK: Belaga District, Murum, Sg. Chak (tributary of Sg. Danum), 20 March 2014, *Ling et al. BMHEP 3826* (holotype SAR!).

NOTES. Very rare and known only from the type locality above the inundated area. The species is not placed in any section as the number of locules and placentas is unknown as no female flowers were available and the only old fruit had already dehisced and its internal structures could not be seen. Live plants were established *ex-situ* in Murum and Semengoh NR.

2. Begonia johariana S. Julia & C.Y. Ling **sp. nov. (**Section *Petermannia*)

Similar to *Begonia pendula* Ridley (1906: 257) in its creeping and somewhat wiry stem but it is different in its ovate leaves with unequally cordate base, 5–9.2 × 3–5 cm (vs. lanceolate with rounded base, 5–6.3 × 2.5–3.8 cm), the acuminate leaf apex with acumen 1–2 cm long (vs. apex acute), the floral bract and bracteoles persistent (vs. caducous), the tepals of male flowers 4 (vs. tepals 2) and the fruits smaller, 5–7 × 10–12 mm (vs. *ca*. 9 × 12 mm). Type**:** *Ling et al. AMHEP 2444*, Borneo, Sarawak, Belaga District, Murum, Sg. Adam, 30 November 2013 (holotype SAR!). (**Fig. 2**)

Creeping wiry herb, sometimes hanging on rocky cliffs. Stems, stipules, petioles and leaves beneath sparsely covered with fine short white hairs, more noticeable on petioles. Stems red-brown, 1–3 mm thick, internodes (2.2–)4–8.5 cm long, branched, succulent, slightly thicker at nodes. Stipules pale green tinged pale red at midrib, ovate, 5–8 × 2–4 mm, margin dentate, apex acuminate, seta 1–2 mm long, persistent. Leaves alternate, distant, oblique, held horizontally; petioles red-brown, 2.5–6(–8) cm long, terete; lamina plain green to dark green above, pale red brown beneath, young leaves tinged peachy-orange, in life succulent, glossy, asymmetric, ovate, 5–9.2 × 3–5 cm, broad side 1.7–3.4 cm wide, base unequally

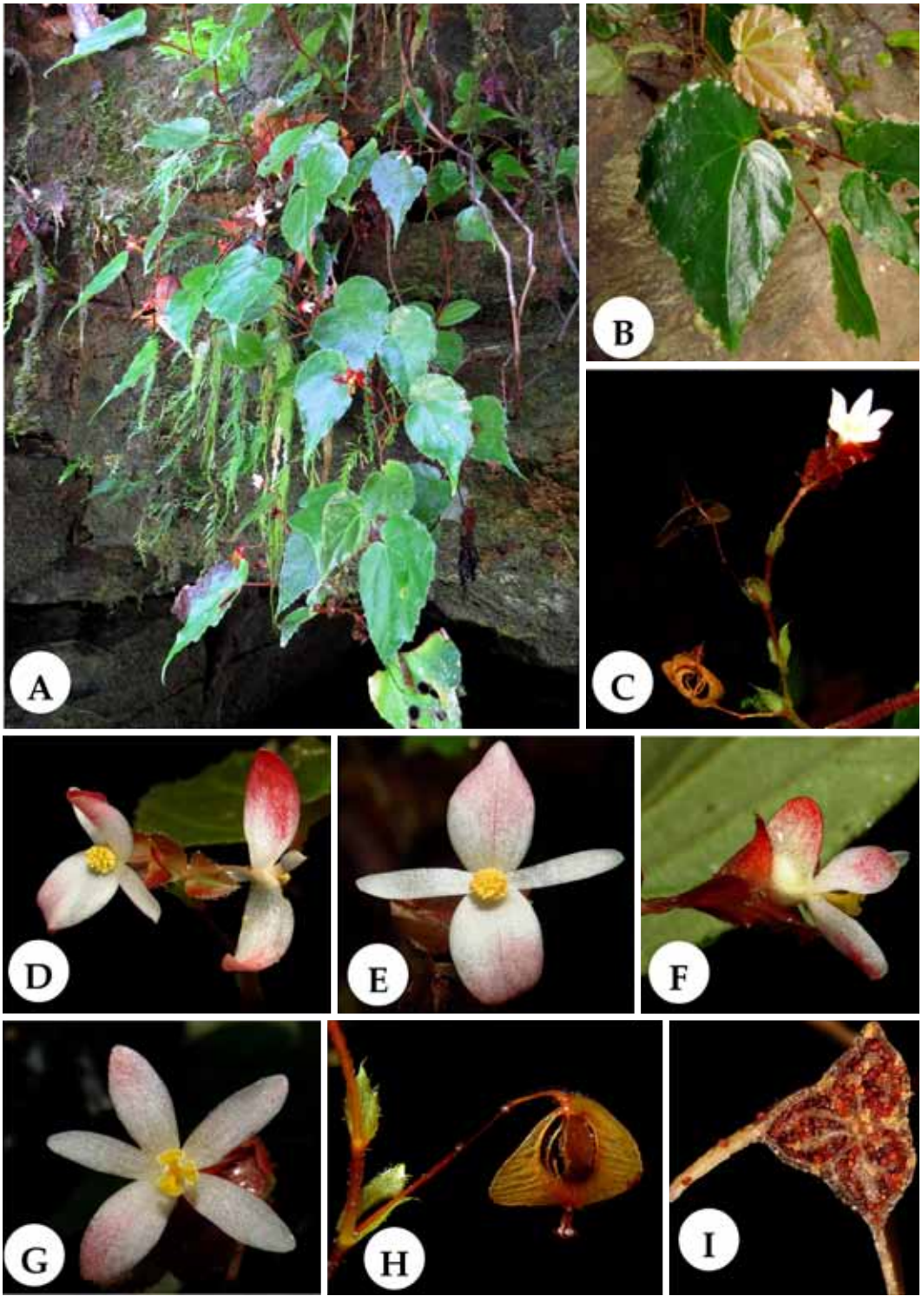

Fig. 2. *Begonia johariana*. **A** & **B.** Habit; **C.** Inflorescence; **D** & **E.** Male flowers; **F** & **G.** Female flower; **H.** Old fruit; **I.** Cross-section of fruit. All Photos from *BMHEP 2444* by Ling Chea Yiing.

cordate, sometimes overlapping, basal lobes 8–20 mm long, margin minutely serrate and sparsely hairy, apex acuminate, acumen 1–2 cm long; venation pinnate-palmate, veins greenish above except near the leaf base, pale green beneath, 2–4 veins on either side of the midrib, 2–3 veins in basal lobe, slightly impressed above, prominent beneath. Inflorescences protogynous, axillary on upper parts of the stem, paniculate to 5 cm long. Bracts pale green, ovate, 5–7 × 2–4 mm, margin ciliate, persistent. Bracteoles 2–4 pairs, lower bracteoles similar to bracts, pale green tinged reddish, 4–6 × 2–5 mm, upper bracteoles reddish, oval, 5–6 × 4–5 mm, keeled, margin ciliate, persistent. Male flowers: pedicel white, *ca*. 3 mm long, glabrous; tepals 4, white inside, white or sometimes reddish towards the apex, glabrous, margin entire, apex broadly acute to rounded, outer 2 tepals broadly ovoid, 7–8 × 5 mm, inner 2 tepals lanceolate, 5–7 × 2–3 mm; stamens *ca*. 40, cluster conical, subsessile; filaments pale yellow, 0.8–1.1 mm long; anthers pale yellow, obovate, 0.8–1 × 0.4 mm, apex emarginate. Female flowers: pedicel reddish green to pale green, *ca*. 3 mm long, glabrous; ovary white or pale green with reddish wings or deep red, broadly elliptic, 5–6 × 8–9 mm, glabrous, wings 3, unequal, locules 3, placentas 2 per locule; tepals 5, white inside, white tinged reddish outside, glabrous, outer 4 tepals elliptic, 6–7 × 2–3 mm, margin entire, apex acute, innermost tepal slightly smaller, *ca*. 5 × 1.5–2 mm; styles 3 rarely 2, pale yellow, *ca*. 2 mm long, divided to base, widely Y-shaped; stigma pale yellow, papillose forming a continuous twisted band. Capsules single on the lower rachis, 5–7 × 10–12 mm, glabrous, locules 3, wings 3, unequal, broadly acute proximally, rounded distally, 2–3 mm wide, thinly fibrous, dehiscing between locule and wing; pedicel pendent, *ca*. 5 mm long.

ETYMOLOGY. Named after Haji Johari bin Atok, Senior Manager of Environmental Impact Assessment Division, SEB, for his strong support for WiMOR project.

ECOLOGY. Riparian forest on mossy sandstone boulders in shaded and consistently wet areas near waterfalls or near streams at 480–554 m elevation.

DISTRIBUTION. Borneo. Endemic to Sarawak (Sg. Danum).

SPECIMENS EXAMINED—BORNEO. SARAWAK: Belaga District, Murum Dam: Sg. Danum — Sg. Danum, *Whillander et al. BMHEP 2554* (SAR); Sg. Adam, *Vilma et al. BMHEP 2045* (SAR); *Ling et al. AMHEP 2444* (holotype SAR); Sg. Po, *Vilma et al. BMHEP 1916* (SAR). Live plants established in Murum and Semengoh NR under accession number *Ling et al. AMHEP 1042* (collected from Sg. Danum), *Andy et al. BMHEP 3661* (collected from Sg. Lemujan, a tributary of Sg. Danum) and *Vilma et al. BMHEP 1951* (collected from Sg. Piling, a tributary of Sg. Danum).

3. Begonia julaihiana S. Julia & C.Y. Ling **sp. nov.** (Section *Petermannia*)

Similar to *Begonia subisensis* K.G. Pearce (2003: 85) in its habit, the woody stems, the lamina coloration and the number of stamens but it is different in its larger stipules, 21–24

× 6–8 mm, that are conspicuously keeled (vs. stipules *ca*. 5.5 × 1.5 mm and not keeled in *B. subisensis*), the petioles are shorter, 4–6 mm long (vs. 10–25 mm long), the basal lobe scarcely developed (vs. basal lobes to 1.3 cm long), the inflorescence longer, 7.5–14.5 cm long (vs. *ca*. 7.5 cm long), the bracts bigger, 10–14 × 4–6 mm (vs. *ca*. 4 × 2.5 mm), the ovary narrower, *ca*. 8 × 11 mm (vs. *ca*. 16 × 20 mm), the fruit pedicel shorter, 1.2–1.5 cm long (vs. *ca*. 3 cm long) and the fruits longer, 1.7–2.5 × 2.5–2.8 cm (vs. 1.4 × 2.3 cm). Type: *Ling et al. AMHEP 1181,* Borneo, Sarawak, Belaga District, Murum, Ulu Sg. Sauh, 18 October 2013 (holotype SAR!). (**Fig. 3**)

Cane begonia to 1 m tall, whole plant glabrous. Stems pale brown, red-brown towards the apex, 6–8 mm thick, internodes (1.3–)3.7–6 cm long, little-branched, woody, thicker at nodes. Stipules pale green or greenish pink, lanceolate, 21–24 × 6–8 mm, margin entire, keeled, apex acuminate, acumen 1–2 mm long, caducous. Leaves alternate, distant, slightly falcate but not oblique, held more or less horizontally; petioles dark red, 4–6 mm long, slightly grooved above; lamina plain bronzy green above, dark red beneath, in life succulent, with reflective sheen above, matt beneath, slightly asymmetric, ovate to lanceolate, (8–)13–16 × (2.8–)4–6 cm, broad side 2–3.7 cm wide, base acute, basal lobes scarcely developed, margin dentate and slightly wavy, apex acuminate, acumen 1–2.6 cm long; venation pinnate, veins greenish above, reddish near the leaf base, reddish beneath, 3–5 veins on either side of the midrib, prominent on both surfaces. Inflorescences protogynous, axillary in the upper leaf axils, rachis 7.5–14.5 cm long with 1–2 female flowers at the base and paniculate male inflorescences at the top of rachis. Bracts pale green, lanceolate, 10–14 × 4–6 mm, margin entire, caducous; bracteoles similar to bracts but smaller, 5–10 × 3 mm, caducous. Male flowers: pedicel reddish or greenish towards the tepals, 4–6 mm long; tepals 2, reddish, sometimes greenish and reddish at the base, oval or rounded, 4–5 × 4 mm, margin entire, apex rounded; stamens *ca*. 26, cluster conical, subsessile; filaments pale yellow, 0.8–1 mm long; anthers pale yellow, obovate, 0.6–0.8 × 0.4–0.6 mm, apex emarginate. Female flowers: pedicel pale green, *ca*. 1 mm long, sparsely pubescent; ovary pale green, wings tips reddish, ovoid, *ca*. 8 × 11 mm, sparsely pubescent, wings 3, equal, locules 3, placentas 2 per locule; tepals 5, pale green tinged red, outer sparsely pubescent, inner glabrous, outer 3 tepals elliptic, 7–9 × 3–4 mm, margin entire, apex acute, inner 2 tepals narrowly elliptic, *ca*. 6 × 2 mm, margin entire, apex acute; styles 3, pale yellow, *ca*. 1 mm long, divided to base, shallowly Y-shaped; stigma pale yellow, papillose forming a continuous twisted band. Capsules in pairs, pale green, tinged reddish, triangular in outline, 1.7–2.5 × 2.5–2.8 cm, glabrous, locules 3, wings 3, equal, acute and unequal proximally, truncate with rounded wings tips distally, 1–1.3 cm wide, thinly fibrous, dehiscing between locule and wing; pedicel pendent 1.2–1.5 cm long, reddish towards the base.

ETYMOLOGY. Named after Julaihi Lai Abdullah, forest botanist and Acting Deputy General Manager, Sarawak Forestry Corporation, who has strongly supported *Begonia* research in Sarawak.

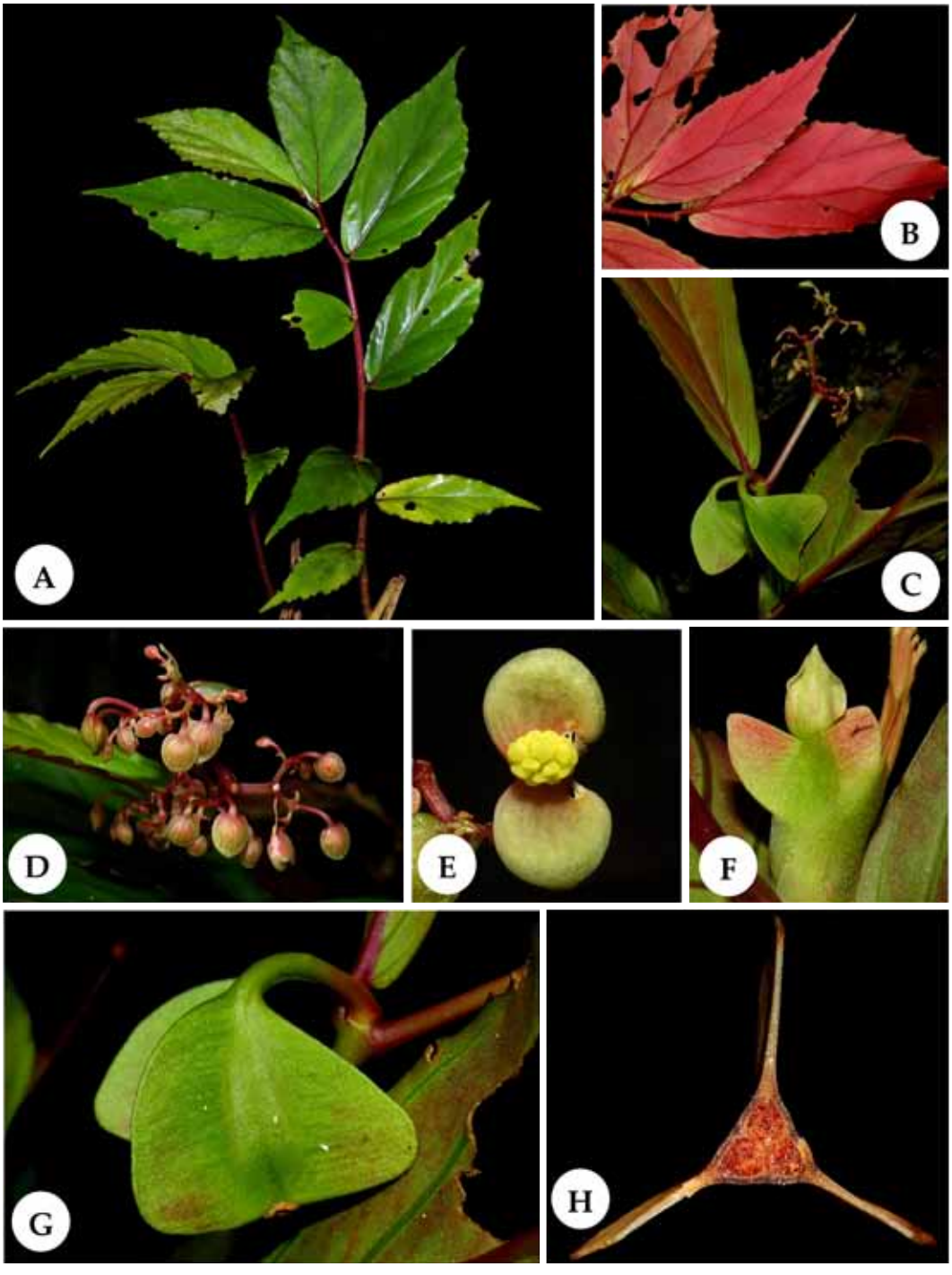

Fig. 3. *Begonia julaihiana*. **A.** Habit; **B.** Undersurface of lamina; **C.** Fruits and male inflorescence; **D.** Male inflorescence; **E.** Male flower; **F.** Female flower (immature); **G.** Fruit; **H.** Cross-section of fruit. Photo **A** from *CMHEP 5099*; Photo **B** from *AMHEP 3687*; Photos **C**–**E** & **G**–**H** from *AMHEP 1181*; Photo **F** from *CMHEP 6058*. Photos **A** & **C**–**H** by Ling Chea Yiing; Photo **B** by Andy Samuel.

ECOLOGY. Stream bank with mossy boulders at 479–590 m elevation.

DISTRIBUTION. Borneo. Endemic to Sarawak (Murum area).

SPECIMENS EXAMINED—BORNEO. SARAWAK: Belaga District, Murum Dam: Sg. Murum — Sg. Sailing, *Andy et al. AMHEP 3687* (SAR); Ulu Sg. Sauh, *Ling et al. AMHEP 1181* (SAR); Sg. Danum — Sg. Jelanok, *Peter et al. BMHEP 3940* (SAR); Sg. Plieran — Sg. Menapun, *Ling et al. CMHEP 6058* (SAR). Live plants established in Murum and Semengoh NR under accession number *Ling et al. AMHEP 2357* (collected from Ulu Sg. Sailing), *Whillander et al. CMHEP 5099* (collected from Sg. Singu, a tributary of Sg. Plieran) and *Ling et al. CMHEP 6019* (collected from Sg. Menaban, a tributary of Sg. Plieran).

NOTES. This species is rather common in the Murum area and also occurs in forest above the inundated areas.

4. Begonia murumensis S. Julia & C.Y. Ling **sp. nov.** (Section *Petermannia*)

Similar to *Begonia lailana* Kiew & C. Geri (2003: 117) in its cane-like habit, hairy stem, not oblique leaf and paniculate inflorescences but it is different in its little-branched and less robust stems, *ca*. 0.5 cm thick (vs. much-branched and robust stems, *ca*. 0.7 cm thick in *B. lailana*), the internodes are shorter,1.8–5.5 cm long (vs. 7–11 cm long), the stipules smaller, *ca*. 7 × 2 mm (vs. 15–27 × 6–10 mm), the lamina lanceolate and narrower, 3–5 cm wide (vs. oblanceolate, 8–10 cm wide) with 4–5 veins on each side of the midrib (vs. 3 veins), the inflorescences are shorter, rachis 4.5–8.5 cm long (vs. rachis 10–16 cm long), the ovary shorter, 10–11 mm long (vs. 13–18 mm long) and the fruits smaller, 12–15 × 11–18 mm (vs. 22–27 × 18–28 mm). Type: *Jacqualine et al. BMHEP 5765*, Borneo, Sarawak, Belaga District, Murum, Sg. Siat (tributary of Sg. Danum), 14 June 2014 (holotype SAR!). (**Fig. 4**)

Cane-like begonia 30–50 cm tall. Stem, petioles, stipules and veins underneath sparsely hirsute, hairs white or brownish. Stems red-brown to dark brown, *ca*. 0.5 cm thick, internodes (1.8–)2–3.5(–5.5) cm long, little-branched, slightly succulent, slightly thicker at nodes. Stipules pale green, lanceolate, *ca*. 7 × 2 mm, keeled, margin entire, apex setose, seta *ca*. 2 mm long, caducous. Leaves alternate, distant, not oblique, held horizontally; petioles red-brown, 0.5–1 cm long, slightly grooved above; lamina dark green above, green sometimes tinged reddish beneath, young leaves bronzy-green or reddish, silvery spots of irregular sizes scattered on upper surface, usually the spots disappear in adult leaves, in life slightly succulent, glabrous, matt or slightly glossy, slightly asymmetric, lanceolate, 10–14(–17) × 3–4(–5) cm, broad side 2–2.5(–3) cm wide, base cuneate on narrow side, rounded on broad side, basal lobes scarcely developed, margin dentate, apex sharply acuminate, acumen to 2 cm long; venation pinnate, veins greenish on both surfaces except near the leaf base, 4–5 veins on either side of the midrib, slightly impressed above, prominent beneath. Inflorescences

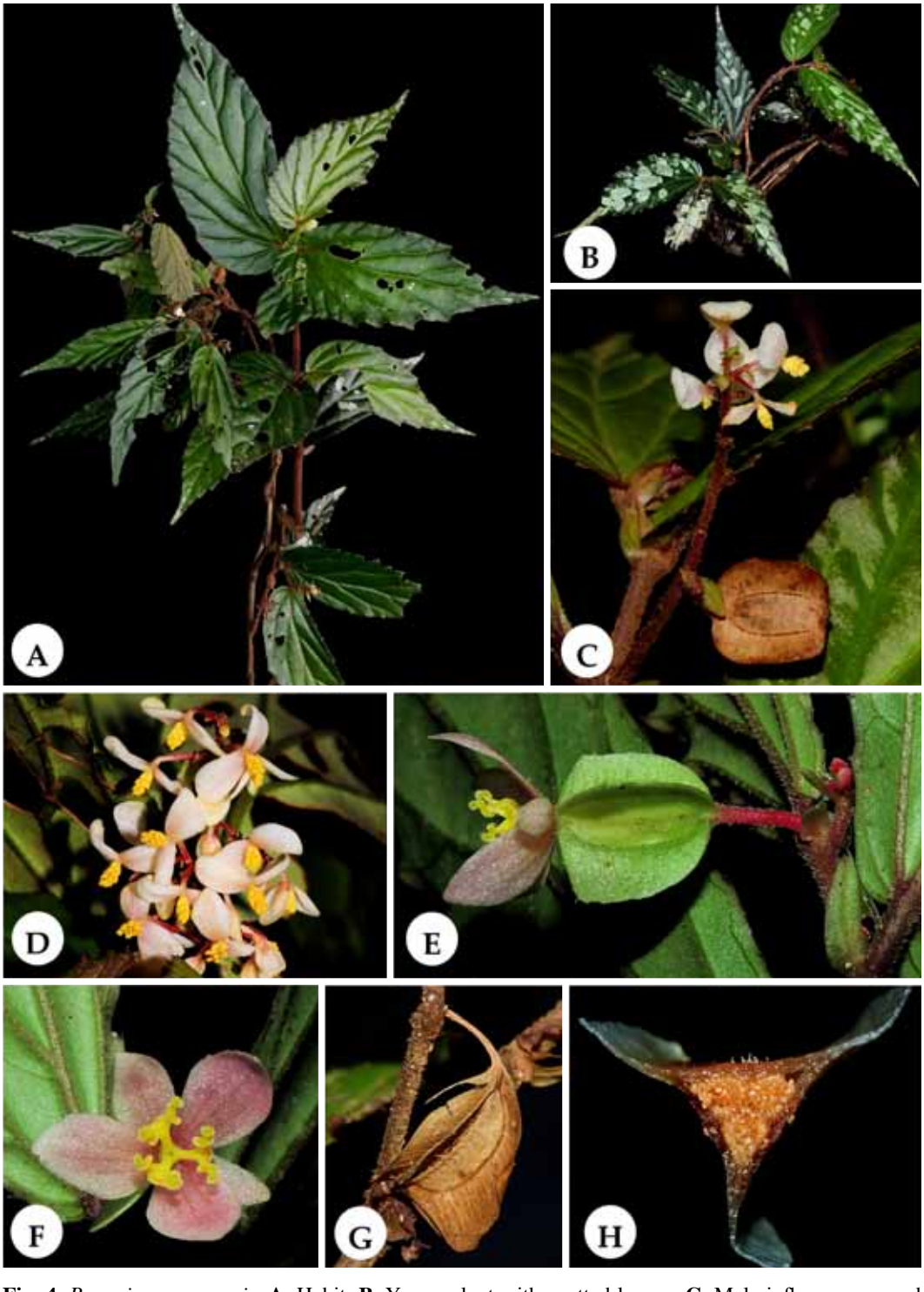

Fig. 4. *Begonia murumensis*. **A.** Habit; **B.** Young plant with spotted leaves; **C.** Male inflorescence and fruit; **D.** Male flowers; **E** & **F.** Female flower; **G.** Old fruit; **H.** Cross-section of fruit. Photos **A** & **C–D** from *BMHEP 5765*; Photo **B** from *CMHEP 4672*; Photos **E–F** & **H** from *BMHEP 4922*; **G** from *AMHEP 1192*. Photos **A–D** & **G–H** by Ling Chea Yiing; Photos **E** & **F** by Vilma Bodos.

protogynous, axillary on upper parts of the stem, with 1–2 female flowers at the base and male inflorescences a panicle, rachis 4.5–8.5 cm long. Bracts pale green or green tinged red, lanceolate, *ca*. 9 × 2 mm, keeled, margin entire, caducous. Bracteoles pale green, lanceolate, *ca*. 6 × 2 mm, margin entire, caducous. Male flowers: pedicel greenish white or pale pink, 2–4 mm long, glabrous; tepals 2, greenish white to completely white or pale pink, glabrous, oval, 4–5 × 3 mm, margin entire, apex rounded; stamens *ca*. 19, cluster conical, sessile; filaments yellow, 0.3–0.4 mm long; anthers yellow, obovate, *ca*. 1 × 0.5 mm, apex emarginate. Female flowers: pedicel pale green or reddish, 6–9 mm long, densely hirsute; ovary pale green, ovate, 10–11 × 7–9 mm, glabrescent, wings 3, equal, locules 3, placentas 2 per locule; tepals 5, pale green or pink, glabrous inside, sparsely hirsute outside, margin entire or sometimes slightly toothed on the upper half, apex acute, outer 2 tepals elliptic, 5–6 × 2–3 mm, inner 3 tepals broadly elliptic, 10–11 × 7–9 mm; styles 3, lemon yellow, *ca*. 3 mm long, divided to base, widely and deeply Y-shaped; stigma lemon yellow, papillose forming a continuous twisted band. Capsules single or in pairs, pale red, 12–15 × 11–18 mm, glabrous, locules 3, wings 3, slightly unequal, broadly acute proximally, rounded or truncate distally, 3–4 mm wide, thinly fibrous, dehiscing between locule and wing; pedicel pendent, *ca*. 8 mm long.

ETYMOLOGY. It takes its name from the Murum area where it is common.

ECOLOGY. On riverbanks with sandy clay soil at 480–561 m elevation.

DISTRIBUTION. Borneo. Endemic to Sarawak (Murum area).

SPECIMENS EXAMINED—BORNEO. SARAWAK: Belaga District, Murum Dam: Sg. Danum, *Vilma et al. BMHEP 4922* (SAR); Sg. Payau, *Suzila et al. BMHEP 2851* (SAR); Sg. Tilin, *Ling et al. BMHEP 1192* (SAR); Sg. Jelanok, *Peter et al. BMHEP 3949* (SAR); Sg. Siat, *Jacqualine et al. BMHEP 5765* (holotype SAR!); Sg. Plieran — Sg. Menawan, *Vilma et al. CMHEP 7* (SAR). Live plants established in Murum and Semengoh NR under accession number *Suzila et al. BMHEP 4671* and *BMHEP 4672* (both collected from Sg. Danum).

NOTES. One of the commonest species in the Murum Dam area. It also occurs in forest above the inundated areas.

5. Begonia plieranensis S. Julia & C.Y. Ling **sp. nov.** (Section *Petermannia*)

Similar to *Begonia fuscisetosa* Sands (1997: 433) in its habit, petiole and inflorescence lengths but it is different in being a shorter plant, *ca*. 40 cm (vs. 60–70 cm tall), its thicker stems 4–5 mm wide (vs. *ca*. 2 mm wide), the hairs on leaves are pale green or white on a green base (vs. red or dark hairs on a dark red base), are sparse and irregularly distributed (vs. dense and regularly distributed), the lamina is larger, 11.2–16 × 5–8 cm (vs. 6–9 ×

2.3–3.5 cm), with broad side 2.7–4.5 cm wide (vs. *ca*. 2 cm wide), the leaf margin is dentate to doubly dentate (vs. serrate with teeth to 1 mm long at the vein endings), the basal lobes are 5–7 mm long (vs. scarcely developed), the fruit pedicel is shorter, *ca*. 8 mm long (vs. 10–14 mm long) and the fruits are narrower, *ca*. 8 mm wide (vs. 10–11 mm wide). Type: *Ling et al*. *CMHEP 5982,* Borneo, Sarawak, Belaga District, Murum, Sg. Plieran, 26 June 2014 (holotype SAR!). (**Fig. 5**)

Erect begonia to 40 cm tall. Stems green to pale green, 4–5 mm thick, internodes 2–5.5(–7.5) cm long, little branched, succulent, slightly thicker at nodes. Stipules pale green, lanceolate, *ca*. 6–9 × 2–3 mm, margin entire, apex acute, caducous. Leaves alternate, distant, slightly falcate but not oblique, held horizontally; petioles pale green to yellow-green, 4–13 mm long, terete above; lamina plain green to pale green above, paler beneath, in life succulent, papery when dry, with sparse, stiff, erect pale greenish or whitish hairs in between of veins on upper surfaces, glossy, asymmetric, obovate to oblanceolate, 11.2–16 × 5–8 cm, broad side 2.7–4.5 cm wide, base asymmetric, basal lobes 5–7 mm long, margin dentate to doubly dentate, teeth to *ca*. 9 mm long, apex acute to acuminate, acumen 1–1.5 cm long; venation pinnate, veins pale yellow-green above, pale green beneath, 3–5 veins on either side of the midrib, 1–2 veins in basal lobe, prominent on both surfaces with sparse short stiff hairs beneath, hairs pale green or whitish. Inflorescences protogynous, axillary in upper leaf axils, with 1–2 female flowers at the base and male inflorescences racemose, 2–6 cm long. Bracts pale green or sometimes whitish, lanceolate, 7–12 × 5 mm, keeled, margin entire, caducous. Bracteoles white to pale green, broadly elliptic, 1–1.3 × 0.8–1 cm, margin entire, persistent. Male flowers: pedicel pale green or white, 4–9 mm long, glabrous; tepals 2, white, glabrous, oval or obovate, 5–8 × 4–5 mm, margin entire, apex rounded; stamens 19–20, cluster conical, torus *ca*. 0.2 mm long; filaments pale yellow, 0.6–1 mm long; anthers pale yellow, obovate, *ca*. 0.6 × 0.5 mm, apex emarginate. Female flowers: pedicel pale green, 4–5 mm long, pubescent; ovary pale green or creamy yellow, ellipsoid, *ca*. 9 × 5 mm, pubescent, wings 3, subequal, locules 3, placentas 2 per locule; tepals 5, white, outer pubescent, inner glabrous, outermost tepals slightly smaller, elliptic, 11–12 × 5 mm, margin entire or toothed in the upper half, apex acute, inner 4 tepals obovate, 12–13 × 5–6 mm, margin toothed on the upper half, apex acute; styles 3, pale yellow, *ca*. 3 mm long, divided to base, shallowly Y-shaped; stigma pale yellow, papillose forming a continuous twisted band. Capsules single or in pairs at the base of rachis, *ca*. 12 × 8 mm, pubescent, locules 3, wings 3, equal, broadly acute proximally, acute to rounded distally, *ca*. 2 mm wide, thinly fibrous, dehiscing between locule and wing; pedicel pendent, *ca*. 8 mm long, pale green.

ETYMOLOGY. The species is named for the locality in which the type specimen was collected (Sg. Plieran).

ECOLOGY. Riparian forest with mossy boulders and rocky banks at 522–567 m elevation.

DISTRIBUTION. Borneo. Endemic to Sarawak (Murum area).

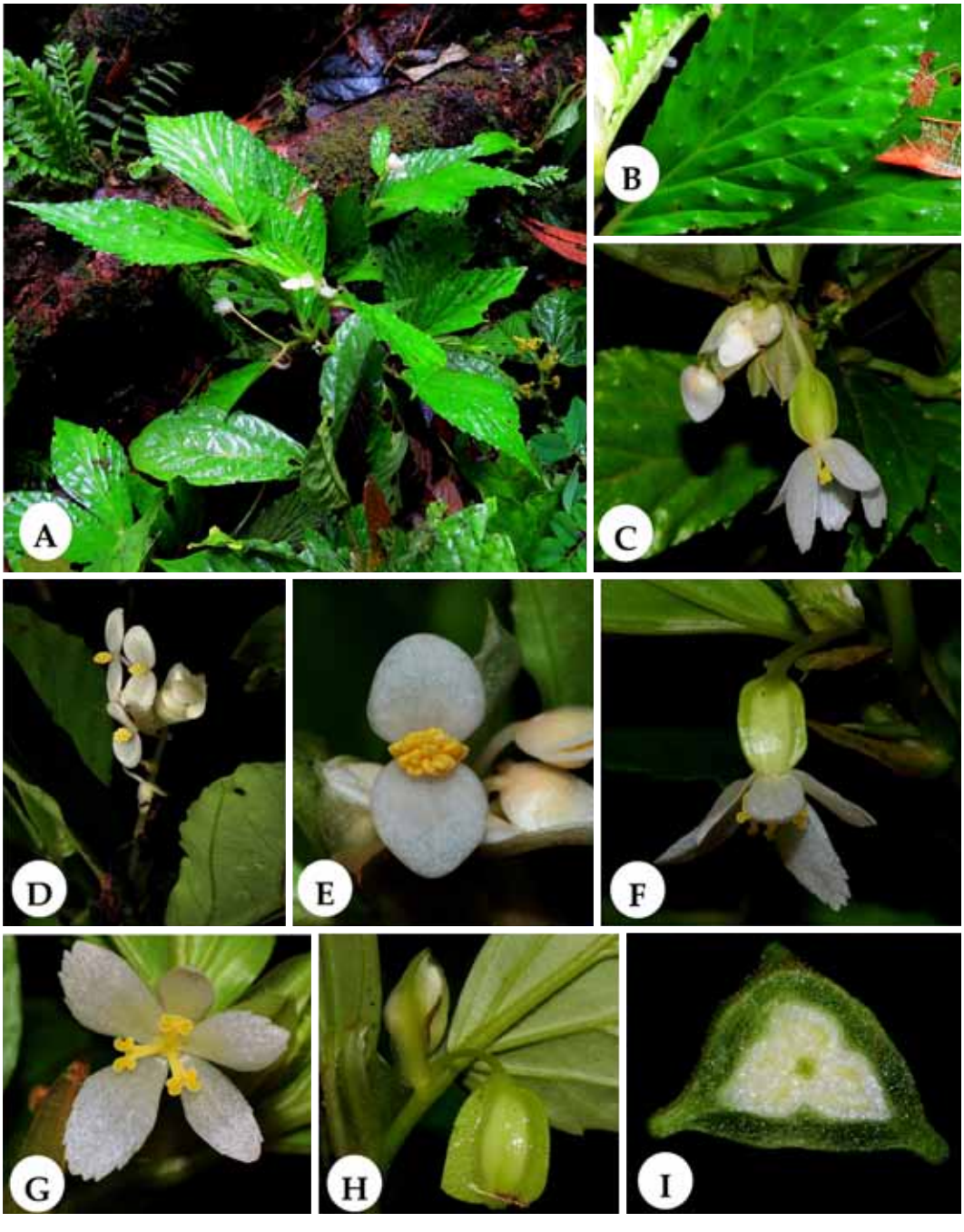

Fig. 5. *Begonia plieranensis*. **A.** Habit; **B.** Upper leaf surface with raised hair bases; **C.** Inflorescence; **D** & **E.** Male flowers; **F** & **G.** Female flowers; **H.** Fruit; **I.** Cross-section of fruits. Photos **A** & **B** from *CMHEP 6602*; Photos **D** & **H** from *CMHEP 5982*; Photos **C**, **E–G** & **I** from *CMHEP 162*. Photos **A** & **B** by Jacqualine Henry; Photos **C–I** by Ling Chea Yiing.

SPECIMENS EXAMINED—BORNEO. SARAWAK: Belaga District, Murum Dam: Sg. Plieran, *Jacqualine et al. CMHEP* 5900 (SAR); *Vilma et al. CMHEP 162* (SAR); *Ling et al. CMHEP 5982* (SAR); Sg. Menapun, *Jacqualine et al. CMHEP 6602* (SAR). Live plants established in Murum and Semengoh NR under accession number *Ling et al. CMHEP 5982* (collected a Sg. Plieran), *Ling et al. BMHEP 3872* (collected from Sg. Danum) and *Ling et al. BMHEP 3824* (collected from Sg. Chak, a tributary of Sg. Danum).

6. Begonia rhodotricha S. Julia & C.Y. Ling **sp. nov. (**Section *Petermannia*)

Similar to *Begonia longiseta* Irmscher (1953a: 499) in its densely hairy stems, petioles and veins but it is different in its alternate and distant leaves with internodes 3–3.5 cm long (vs. 2–4 cm long between the pairs of sub-opposite leaves associated with the inflorescence and 3–5 mm long between the internodes of the subopposite leaves), the stem is thicker, *ca*. 8 mm thick (vs. 2–3 mm thick), the petioles longer, 6–13 mm long (vs. 3–5 mm long), the female flowers solitary and the male flowers in simple cymes (vs. racemose inflorescence with lateral cymes), the male flowers have shorter pedicels, *ca*. 6 mm long (vs. *ca*. 12 mm long) and 4 tepals (vs. 2 tepals) and the female flowers have a larger ovary, 10–14 × 9 mm (vs. 6.5–8.5 × 4–5 mm). Type: *Ling et al. AMHEP 3819,* Borneo, Sarawak, Belaga District, Murum, Sg. Danum, 20 March 2013 (holotype SAR!). (**Fig. 6**)

Erect begonia to 45 cm tall. Stems brown, 3–8 mm thick, internodes 3–3.5 cm long, densely pilose, hairs white, little-branched, slightly succulent, slightly thicker at nodes. Stipules pale green, triangular, 8–12 × 2–3 mm, densely pilose, hairs white, margin entire, apex pointed, caducous. Leaves alternate, crowded, not oblique, held horizontally; petioles greenish brown, (0.2–)0.6–1.3 cm long, slightly grooved above; lamina plain green above, pale green beneath, in young leaves sometimes with silvery patches on the upper surface, in life slightly succulent, glabrous or sparsely bristly above, densely pubescent beneath, glossy, slightly asymmetric, broadly ovate, 9–14(–19) × 4–7(–7.5) cm, broad side 2.5–4.5 cm wide, base cordate, sometimes overlapping, basal lobes *ca*. 5 mm long, margin serrate, apex acuminate, acumen to 5–7 mm long; venation pinnate, veins greenish on both surfaces except near the leaf base, 3–5 veins on either side of the midrib, 1–2 veins in basal lobe, slightly impressed above, prominent beneath. Inflorescences protogynous, axillary with solitary female flowers and male flowers in simple cymes. Bracts of male flowers red, lanceolate, *ca*. 6 × 2 mm, densely pilose, hairs white, margin entire, persistent. Bracteoles of male flowers similar to bracts but smaller, *ca*. 4 × 2 mm, persistent. Male flowers: pedicel white, *ca*. 6 mm long, densely pilose, hairs white; tepals 4, white or white tinged pale pink and glabrous inside, outside reddish and densely pilose, hairs red, margin entire, outer 2 tepals oval, 6–7 × 5–6 mm, apex acute, inner 2 tepals narrowly oblanceolate, 6–7 × 2–3 mm, apex rounded; stamens *ca*. 27, sessile; filaments pale yellow, *ca*. 1 mm long; anthers pale yellow, obovate, *ca*. 0.5 × 0.2 mm, apex emarginate. Bracts of female flowers magenta or white, broadly ovate, *ca*. 5 × 4 mm, densely pilose, hairs reddish or pinkish, margin ciliate, persistent. Bracteoles

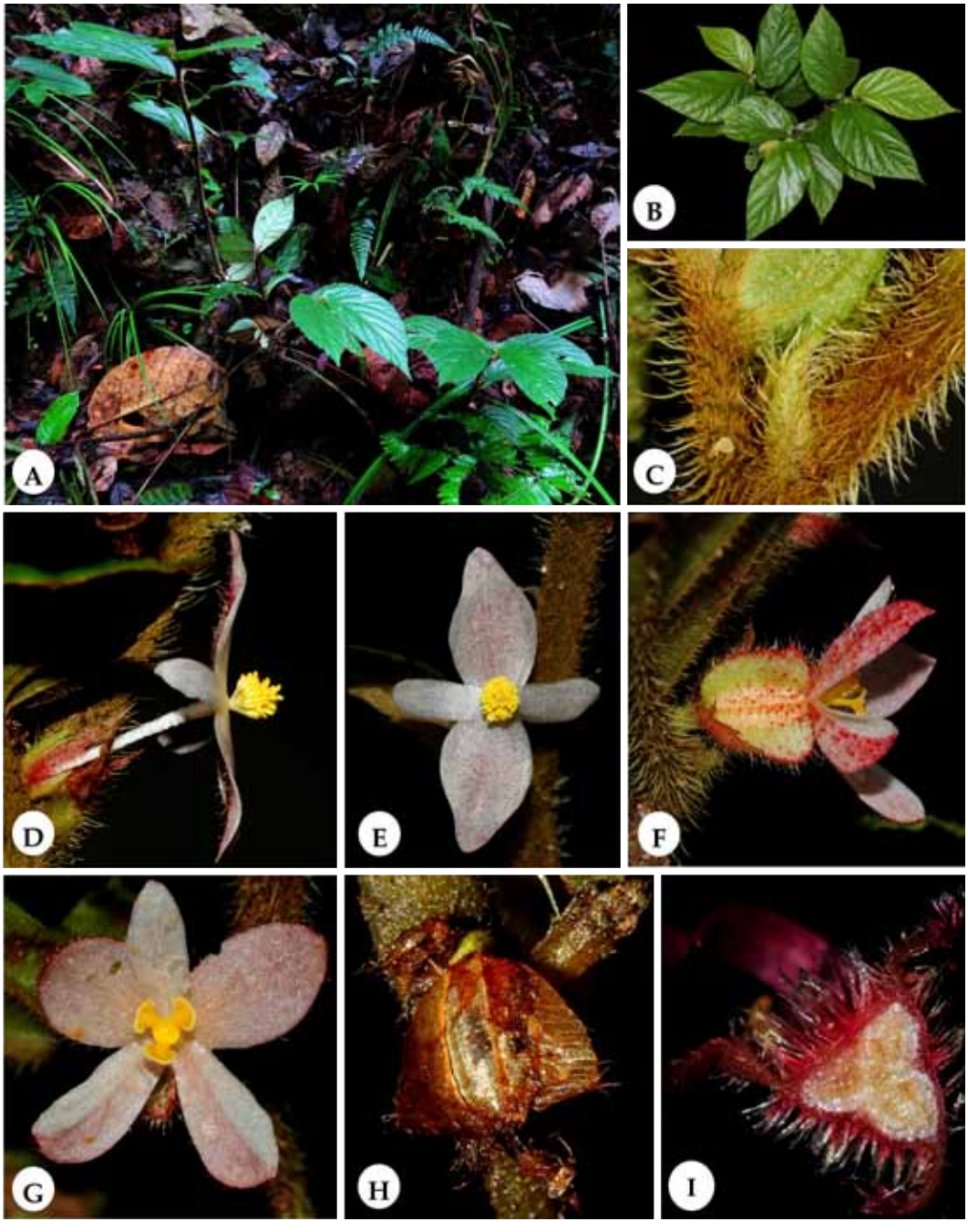

Fig. 6. *Begonia rhodotricha*. **A** & **B.** Habit; **C.** Stipule and petiole; **D** & **E.** Male flower; **F** & **G.** Female flower; **H.** Old fruit; **I.** Cross section of ovary. Photo **A** from *CMHEP 6062*; Photos **B** & **C** from *BMHEP 3963*; Photos **D–E** & **H** from *BMHEP 3819*; Photos **F–G** & **I** from *BMHEP 5764*. All photos by Ling Chea Yiing.

of female flowers similar to bracts but smaller, *ca*. 3 × 1 mm, persistent. Female flowers: pedicel pale green, 5–6 mm long, hairy; ovary green to greenish yellow or white, ovoid, 10–14 × 9 mm, sparsely pilose, hairs whitish or reddish with red or pink bases, wings 3, equal, locules 3, placentas 2 per locule; tepals 5, yellowish green to white or pale pink and glabrous inside, pink and densely pilose outside, hairs reddish or pinkish, margin entire, apex acute, outer 4 tepals elliptic, 8–9 × 5–6 mm, innermost one narrowly elliptic, *ca*. 8 × 4 mm; styles 3, yellow to orange-yellow, *ca*. 2 mm long, divided to base, shallowly Y-shaped; stigma yellow, papillose forming a continuous twisted band. Capsules single or in pairs, pale green, *ca*. 15 × 10 mm, hairy, locules 3, wings 3, equal, rounded proximally, rounded or truncate distally, *ca*. 3 mm wide, thinly fibrous, dehiscing between locule and wing; pedicel erect, 6–8 mm long.

ETYMOLOGY. Greek, *rhodos* = reddish; *trichos* = hairs, referring to the reddish hairs on the flowers and fruits.

ECOLOGY. Riparian on shaded riverbanks, near waterfalls with large boulders or in hill forest near streams at 514–574 m elevation.

DISTRIBUTION. Borneo. Endemic to Sarawak (Murum area).

SPECIMENS EXAMINED—BORNEO. SARAWAK: Belaga District, Murum Dam: Sg. Danum, *Ling et al. BMHEP 2426* (SAR); *BMHEP 3870* (SAR); *BMHEP 3868* (SAR); Sg. Lemunjan, *Andy et al. BMHEP 3661* (SAR); Sg. Chak, *Ling et al. BMHEP 3818* (SAR); *BMHEP 3819* (holotype SAR); Long Malim, *Rantai et al. BMHEP 3107* (SAR); Sg. Siat, *Jacqualine et al. BMHEP 5770* (SAR); *BMHEP 5771* (SAR); *BMHEP 5764* (SAR); Sg. Pampong, Peter *et al. BMHEP 3963* (SAR), Sg. Plieran — Sg. Menawan, *Vilma et al. CMHEP 0062* (SAR); Sg. Penampan, *Rantai et al. CMHEP 2754* (SAR), Sg. Menapun, Ling *et al. CMHEP 6062* (SAR). Live plants established in Murum and Semengoh NR under accession number *Ling et al. BMHEP 2426*, *BMHEP 3870, BMHEP 3868, Andy et al. BMHEP 3661, Ling et al. BMHEP 3818*, *BMHEP 3819, Rantai et al. BMHEP 3107* and *Jacqualine et al. BMHEP 5764*.

NOTES. It is a common species that also occurs in forest above inundated area.

7. Begonia rhombipetala S. Julia & C.Y. Ling **sp. nov.** (Section *Petermannia*)

Similar to *Begonia lunatistyla* Irmscher (1953a: 503) in its habit, slightly falcate leaves and the indumentum on the stems but it is different in its longer internodes 1.5–2 cm long (vs. 0.6–1.2 cm long in *B. lunatistyla*), the lamina sparsely hirsute above and beneath (vs. glabrous above), the veins 3–4 on each side of the midrib (vs. 1–2 veins on each side of the midrib), the tepals of male flower are isomorphic and larger, *ca*. 14 × 9 mm (vs. dimorphic

and smaller, outer ones 3–6.3 × 3–6 mm, inner ones 3–6 × 2.3–4 mm), the tepals of female flower are larger, *ca*. 10 × 7 mm (vs. 4.5–5 × 2–2.5 mm), the capsule is larger, *ca*. 12 × 12 mm with a longer pedicel, 12–14 mm long (vs. capsule 7–11 × 5–6 mm and pedicel 2–3 mm long). Type: *Ling et al. AMHEP 2368*, Borneo, Sarawak, Belaga District, Sg. Murum, 27 November 2013 (holotype SAR!). (**Fig. 7**)

Low herb, sometimes decumbent, erect stem to 30 cm tall. Stems, stipules, petioles and veins beneath densely hirsute, hairs magenta, 2–2.5 mm long. Stems red-brown, *ca*. 0.5 cm thick, internodes 1.5–2 cm long, unbranched, succulent, slightly thicker at nodes. Stipules red, lanceolate, 9–10 × 4–5 mm, margin entire, apex setose, seta *ca*. 3 mm long, persistent. Leaves alternate, crowded, falcate but not oblique, held horizontally; petioles red, (0.8–)1.2–2 cm long, slightly grooved or terete above; lamina plain metallic green to olive green above, dark red beneath, young leaves tinged peachy-orange, in life succulent, sparsely hirsute above and beneath, hairs magenta, glossy, slightly asymmetric, lanceolate to oblanceolate, (8.5–)10.5–14 × (2.5–)3.5–5 cm, broad side 2–3.5 cm wide, base acute or slightly rounded, basal lobes *ca*. 5 mm long, margin minutely serrate, apex acute or shortly acuminate, acumen to 1 cm long; venation pinnate, veins greenish above except near the leaf base, magenta beneath, 3–4 veins on either side of the midrib, 1–2 veins in basal lobe, slightly impressed above, prominent beneath. Inflorescences protogynous, axillary usually on lower parts of the stem, sometimes towards the upper leaves, with single female flower or a pair of female flowers at the base, male inflorescences a simple cyme to 4–6 mm long. Bracts magenta, lanceolate, *ca*. 8 × 2 mm, margin entire, persistent. Bracteoles magenta, lanceolate, *ca*. 3 × 1 mm, margin entire, persistent. Male flowers: pedicel white, *ca*. 8 mm long, glabrous; tepals 4, isomorphic, pure white, crystalline, glabrous, ovoid, *ca*. 14 × 9 mm, margin slightly toothed towards the apex or entire, apex acute; stamens 10–18, torus *ca*. 0.5 mm long; filaments yellow, 2.5–3 mm long; anthers lemon yellow, obovate, 0.5–0.8 × 0.4 mm, apex emarginate. Female flowers: pedicel reddish near the base, otherwise white, *ca*. 9 mm long, glabrous; ovary completely white when young, later turning reddish, ovoid, *ca*. 10 × 10 mm, glabrous, wings 3, equal, locules 3, placentas 2 per locule; tepals 5, white, crystalline, glabrous, rhomboid, strongly and abruptly narrowed to the base, *ca*. 10 × 7 mm, margin entire, apex acute; styles 3, lemon yellow, *ca*. 3 mm long, divided to base, deeply Y-shaped; stigma lemon yellow, papillose forming a continuous twisted band. Capsules single or in pairs, white tinged red, *ca*. 12 × 12 mm, glabrous, locules 3, wings 3, equal, acute proximally, rounded distally, *ca*. 5 mm wide, thinly fibrous, dehiscing between locule and wing; pedicel pendent, 1.2–1.4 cm long.

ETYMOLOGY. Greek, *rhombos* = rhomboid; *petalon* = petal; referring to the shape of the tepals of female flower.

ECOLOGY. Riparian or mixed dipterocarp forests near small creeks at 490–820 m elevation.

DISTRIBUTION. Borneo. Endemic to Sarawak (Murum area).

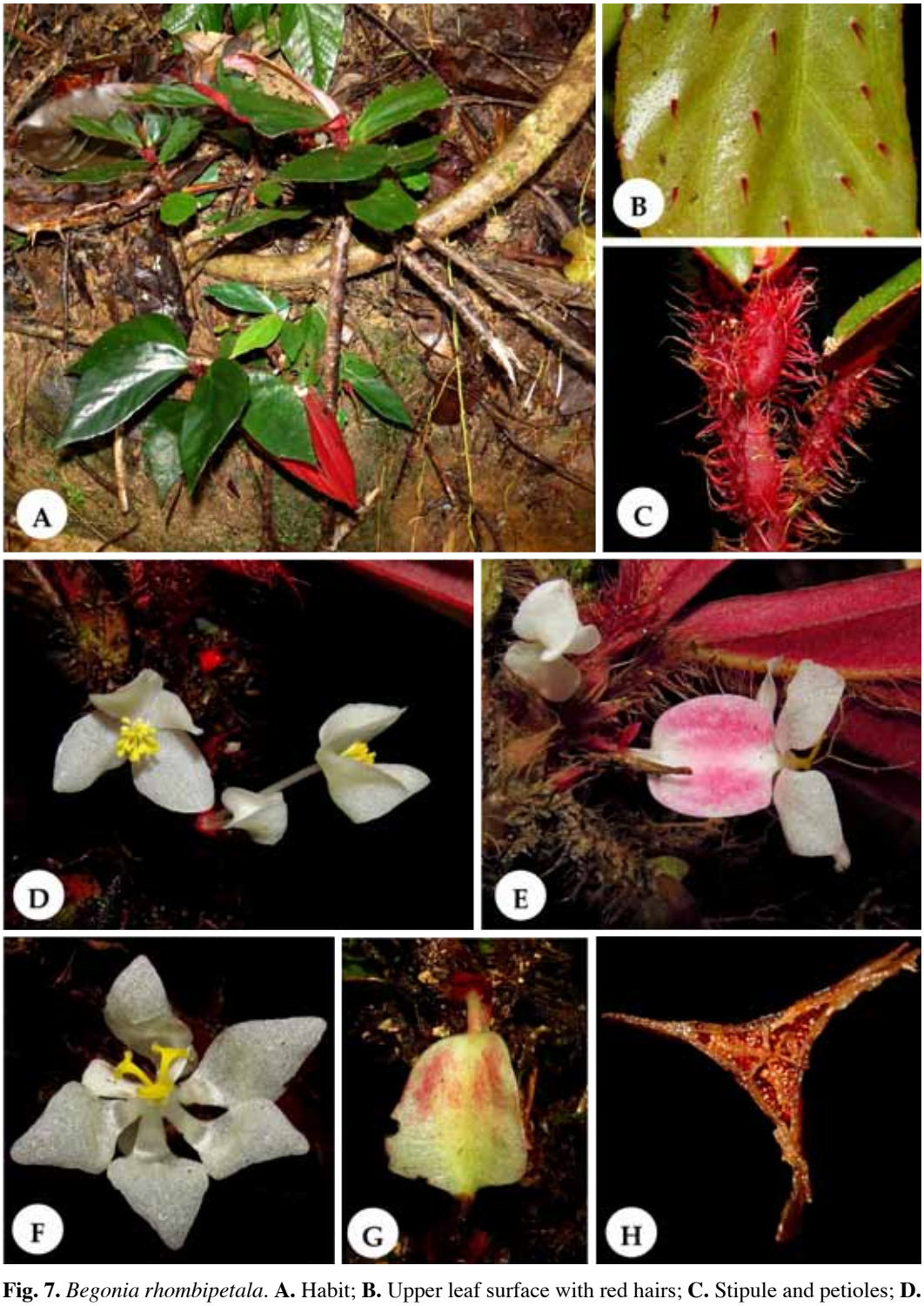

Fig. 7. *Begonia rhombipetala*. **A.** Habit; **B.** Upper leaf surface with red hairs; **C.** Stipule and petioles; **D.** Male flowers; **E** & **F.** Female flowers; **G.** Fruit; **H.** Cross-section of fruit. Photos **A**–**C** & **F** from *AMHEP 2355*; Photos **D**–**E** & **G**–**H** from *AMHEP 1148*. All photos by Ling Chea Yiing.

SPECIMENS EXAMINED—BORNEO. SARAWAK: Belaga District, Murum Dam: Sg. Murum — Sg. Sailing, *Ling et al. AMHEP 1148* (SAR); Ulu Sg. Sauh, *Ling et al. AMHEP 2355* (SAR); Sg. Sauh, *Vilma et al. AMHEP 1883* (SAR); Sg. Murum, 27 November 2013, *Ling et al. AMHEP 2368* (holotype SAR!); Sg. Plieran — Sg. Menapun, *Julia et al. CMHEP 4403* (SAR). Live plants established in Murum and Semengoh NR under accession number *Ling et al. CMHEP 1145*(collected from Sg. Sailing); *Andy et al. CMHEP 3637* (collected from Sg. Menapun).

NOTES. This species is quite common in the Murum area. It also occurs in forest above the inundated area.

8. Begonia tenuissima S. Julia & C.Y. Ling **sp. nov.** (Section *Petermannia*)

Like *Begonia xiphophylla* Irmscher (1953b: 100) in its narrow leaves but it is different in its even narrower leaves, 8–18 mm wide (vs. 18–26 mm wide in *B. xiphophylla*), smaller, 3–5 × 2 mm, and caducous stipules (vs. 5–8 × 3 mm and persistent), the internodes longer, 2–4 cm long (vs. 1–2 cm long), the capsules longer, *ca.* 14–20 × 8–10 mm (vs. *ca.* 10 × 12 mm), the pedicel longer, *ca.* 20 mm long (vs. 10–12 mm long), the female flowers with a larger ovary, *ca.* 12 × 7 mm (vs. 4–6 × 2–4 mm) and the male flowers with 2 tepals (vs. 4 tepals in *B. xiphophylla*). Type: *Jacqualine et al. CMHEP 6606,* Borneo, Sarawak, Belaga District, Murum Dam, Sg. Plieran, 15 September 2014 (holotype SAR!). **(Fig. 8**)

Erect begonia to 50 cm tall. Stems reddish brown, 3–4 mm thick, internodes 2–4 cm long, much-branched, slightly thicker at nodes, becoming woody in old plants. Stipules pale green, linear, 3–5 × 2 mm, margin entire, apex acute, caducous. Leaves alternate, distant, not oblique, held more or less horizontally; petiole reddish, 3–5 mm long, glabrous, grooved above; lamina plain green, paler beneath, in life slightly fleshy, matt, narrowly lanceolate, (8.5–)10–15 × (0.8–)1–1.8 cm, asymmetrical, broad side 0.5–0.8 cm wide, basal lobe inconspicuous, base unequal, acute, margin irregularly toothed at veins ending, teeth 3–5 mm long, apex sharply acuminate, acumen 1.5–2 cm long; venation pinnate, concolorous, 3–4 on each side of the midrib, sunken above, slightly prominent beneath. Inflorescence protogynous in the uppermost leaf axils, to 8 cm long, racemose, 1–2 female flowers and many male flowers, peduncle 3–5 cm long. Bracts pale green, linear, *ca.* 5 × 2 mm, apex acute, margin entire, caducous. Bracteoles pale green, linear, *ca.* 3 × 1 mm, margin entire, caducous. Male flowers: pedicel pinkish, 1.8–2 mm long; tepals 2, pale pink, oval, 2–4 × 1.2–2 mm, glabrous, margin entire, apex acute; stamens *ca.* 18, cluster conical, subsessile; filaments pale yellow, 0.2–0.3 mm long; anthers pale yellow, obovate, 0.8–1 × 0.5 mm, apex emarginate. Female flower: pedicel 6–9 mm long, reddish, glabrous; ovary pale green, glabrous, triangular in outline, 12–16 × 6–7 mm, wings 3, equal, locules 3, placentas 2 per locule; tepals 5, pinkish, lanceolate, more or less isomorphic, 7–10 × 3–5 mm, glabrous, margin entire, apex acute; styles 3, pale yellow, deeply Y-shaped, *ca.* 2 mm long, divided

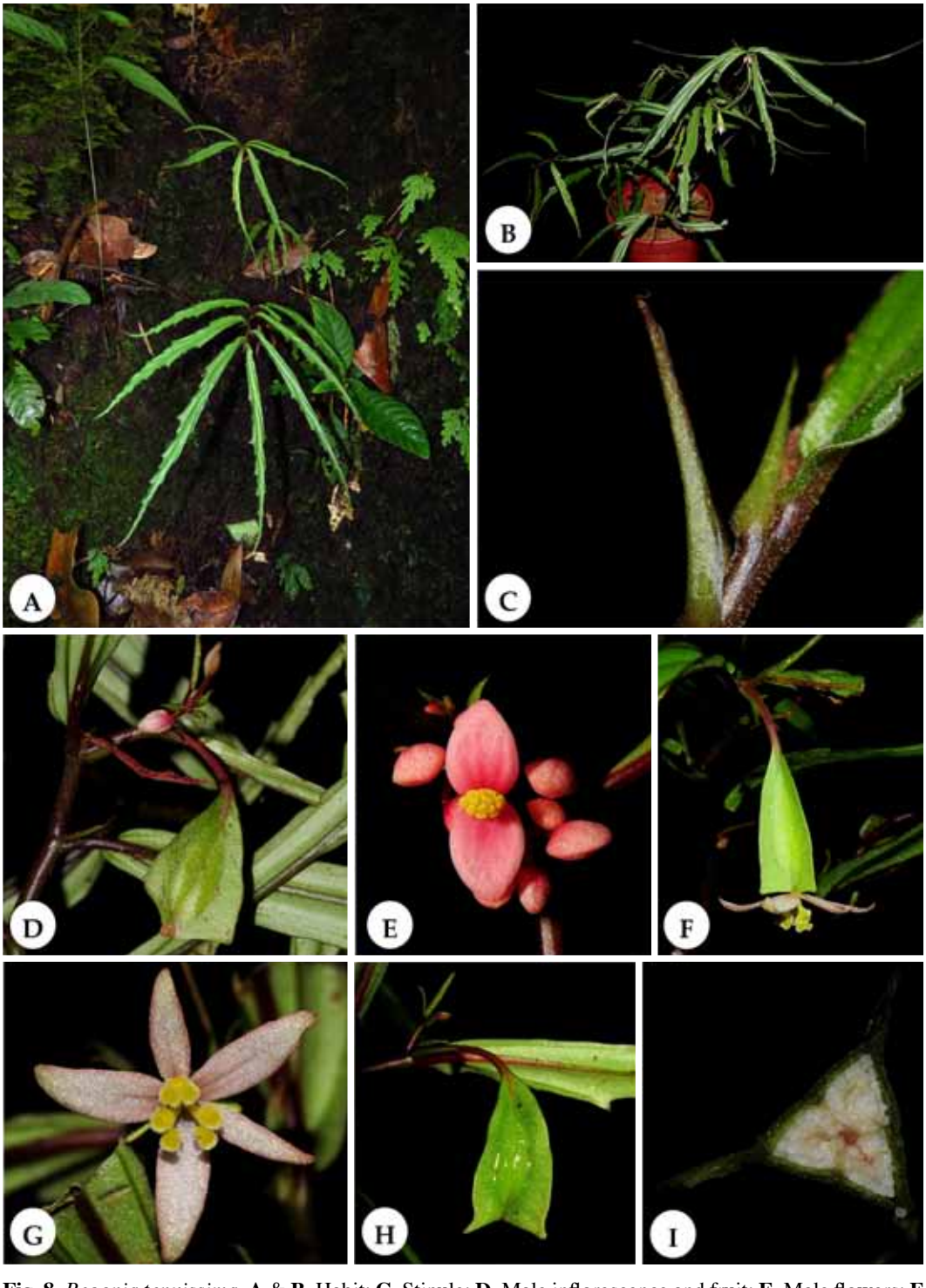

Fig. 8. *Begonia tenuissima*. **A** & **B.** Habit; **C.** Stipule; **D.** Male inflorescence and fruit; **E.** Male flowers; **F** & **G.** Female flowers; **H.** Fruit; **I.** Cross-section of fruit. Photos **A**–**B** & **E**–**H** from *CMHEP 6913*; Photo **C** from *CMHEP 6606*; Photos **D** & **I** from *CMHEP 5897*. All photos by Ling Chea Yiing.

to base; stigma yellow, papillose forming a continuous twisted band. Capsules at the base of rachis,14–20 × 8–10 mm, glabrous, locules 3, wings 3, equal, broadly acute proximally, truncate distally, 2–5 mm wide, thinly papery, dehiscing between the locule and wing; pedicel pendent, 10–20 mm long, glabrous.

ETYMOLOGY. Latin, *tenuissima* = the narrowest; referring to the leaf shape that is the narrowest of any Bornean *Begonia* species.

ECOLOGY. Deeply shaded mossy rock surfaces or mossy steep slopes at 541–589 m elevation.

DISTRIBUTION. Borneo. Endemic to Sarawak (Sg. Plieran).

SPECIMENS EXAMINED—BORNEO. SARAWAK: Belaga District, Murum Dam: Sg. Plieran, *Jacqualine et al. CMHEP 5897* (SAR); Sg. Plieran, 15 September 2014, *Jacqualine et al. CMHEP 6606* (holotype SAR!); *Ling et al. CMHEP 6913* (SAR). Live plants established at Murum and Semengoh NR.

NOTES. The species also occurs above the inundated area but it has a very localised distribution and has only been recorded from Sg. Plirean.

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